of such publications, appearing as single books, or articles in journals not usually destined and used for astronomical publications, would kindly communicate them to me.

*Strassburg (Elsass), Nicolausring* 37,
1899 *January.*

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*Note on Dr. Rambaut's Remarks in the "Monthly Notices" for November* 1898. By David Gill, C.B., F.R.S., &c., Her Majesty's Astronomer at the Cape of Good Hope.

I would gladly allow the existing controversy with Dr. Rambaut to rest on what has been written, were it not that in his final remarks (*Monthly Notices*, lix. p. 3) Dr. Rambaut makes no admission of the error of his original conclusion—viz. that atmospheric chromatic dispersion may be regarded as the origin of certain systematic errors which entered into my observations for determining the parallax of *α Centauri.*

It is this conclusion, and this alone, which I set out to dispute. It is the only point of fundamental importance in the discussion, and Dr. Rambaut persistently evades it by introducing discussions and remarks on side issues.

It is but fair to ask Dr. Rambaut whether he *now* maintains that his original re-discussion of my observations for the parallax of $\alpha_2$ *Centauri* can be regarded as a legitimate one, and as affording evidence of the existence of a term depending on

$$\tan \zeta \cos (p-q).$$

If he does not reply I must conclude that he admits his original explanation and solution to be erroneous.

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*On a Method of Obtaining Perfectly Circular Dots unaffected by phase, and their employment in determining the Pivot Errors of the Cape Transit Circle.* By David Gill, C.B., F.R.S., H.M. Astronomer at the Cape.

One of the chief difficulties in determining the errors of pivots of Transit Circles is that of obtaining a mark which, rotating with the pivot, can be bisected by the observer with perfect certainty in all positions of the telescope.

When the pivots of a transit circle are not perforated, as in the old Cambridge transit instrument, a dot may be engraved on the end of each pivot or upon plates attached to the ends of the pivots, and the vertical and horizontal coordinates of these dots in different positions of the instrument may be measured by a micrometer which is attached to the pier or to

the support of the pivot. But it is beyond the instrument maker's art to engrave a dot which is at once sufficiently small and sufficiently true and clean at the edge to form a reliable mark for the purpose; at least I have never seen an engraved dot (when its surrounding field is illuminated by reflected light) so sharp and clean in outline that one could feel assured of estimating the same centre when different diameters are exposed to the same direction of illumination. When the pivots are hollow, as in the Greenwich and Cape Transit Circles, and an object-glass is fixed in one of the pivots, whilst a metal plate perforated by a small hole is fixed in the opposite pivot in the principal focus of the object-glass, we have a rotating collimator, and, by measuring the coordinates of its axis in rotation by means of a fixed collimator with a micrometer eye-end, we can determine the combined effects of the errors of both pivots on the level and azimuth of their true axis.

We have here also the advantage of employing a point of reference which is not subject to phase by varying direction of illumination, but there remains the difficulty of making a hole sufficiently small, and at the same time perfectly true and sharp in its circular outline.

With an apparatus of this kind, and an observing telescope resting on Y bearings fixed to a wooden bracket bolted to the pier, the combined errors of the pivots of the Cape Transit Circle were investigated by Sir Thomas Maclear soon after the erection of the instrument, and subsequently the operation was repeated by Mr. Stone.

I also made an attempt in 1880 to determine the pivot errors in this way, but the observing telescope was not sufficiently stable, the hole was not sharp and true enough in outline, nor could it be brought sufficiently coincident with the axis of rotation to permit a complete distinction between the errors of the micrometer-screw and the errors of the pivots.

The results of all these investigations tended to show that the pivot errors were smaller than the errors which were inseparable from the defects of the apparatus.

In 1897 I had the following changes in the apparatus made by Mr. Simms:—

1. The object-glass of the western pivot was refigured and very perfectly secured in its mounting.
2. In lieu of an image of a small hole in the focus of the pivot object-glass, the following method was adopted for forming a perfectly opaque and circular dot:—

A circular plate of thin glass (the cover of a microscope slide) was held for an instant over the fumes of boiling mercury. On examination under the microscope, the glass is seen to be covered with numerous minute spheres of mercury which have been condensed on its surface. By means of a camel's hair-brush or a pointed bit of wood all these

spheres, except one near the centre of the plate, were removed. A similar circular cover was then heated over a spirit flame till a small portion of Canada balsam, placed on its upper surface, is melted. This latter disc is then placed with its balsam-covered face upon the surface of the first disc, and the two discs are pressed together. When the Canada balsam has completely set, we have the small mercury sphere securely held in its place between the glass discs. The single disc thus formed was then mounted on the pivot in a suitable holder, which permitted the dot to be truly focussed in the principal focus of the object-glass in the opposite pivot, and to be centred by suitable adjusting screws in the axis of the pivots.

3. In lieu of the 46-inch telescope previously used as the fixed collimator, the beautiful object-glass of the old Dollond 10-foot transit instrument was mounted in a suitable tube, one end of which was supported on an iron standard resting on the western pier, whilst the eye-end passed through a hole made in the solid masonry of the western wall of the transit circle room, and was supported there by another iron standard resting in the wall.
4. The Repsold micrometer of the photographic measuring apparatus was firmly mounted at the eye-end of this telescope, the axis of one of its screws being made truly vertical by a plumb line, and the readings were made by an assistant in the adjoining room.

When this apparatus was properly focussed and adjusted and the glass plate was illuminated by an electric incandescent lamp with frosted glass bulb placed in the direction of the axis of rotation at about 4 feet distant from the eastern pivot, the mercury dot appeared in a bright field as a perfectly sharp and circular black disc of about three seconds of arc in diameter, capable of the most perfect bisection, and so nearly centred as to appear at rest in the field of view whilst the telescope was rotated.

Observations were then made as follows :—

The setting circle was pointed to N.P.D. 0°, and the mercury dot was bisected by the horizontal screw ; then the setting was changed to N.P.D. 5° and the dot again bisected, and so on till the dot had been bisected at each 5th degree of the circle readings. The operation was then immediately repeated in the reverse order.

A similar operation was then performed with the vertical screw.

Four such operations constituted a complete group. The means of all the readings were then taken for the observations with each screw, and the respective means were subtracted from the mean readings for each 5th degree of N.P.D.

The results are given in the following table:—

| N.P.D. | Horizontal Screw Group. I. | Horizontal Screw Group. II. | Vertical Screw Group. I. | Vertical Screw Group. II. |
|---|---|---|---|---|
| ° | d | d | d | d |
| 0 | +0·46 | +0·45 | −0·73 | −0·95 |
| 5 | + ·25 | +0·20 | −0·93 | −0·86 |
| 10 | + ·45 | +0·13 | −1·17 | −0·81 |
| 15 | + ·15 | −0·12 | −1·18 | −1·12 |
| 20 | + ·05 | −0·07 | −1·39 | −1·17 |
| 25 | + ·08 | −0·26 | −1·55 | −1·33 |
| 30 | + ·09 | −0·03 | −1·50 | −1·55 |
| 35 | + ·14 | −0·03 | −1·43 | −1·28 |
| 40 | + ·09 | −0·14 | −1·60 | −1·58 |
| 45 | + ·18 | +0·06 | −1·48 | −1·97 |
| 50 | + ·11 | −0·07 | −1·67 | −1·52 |
| 55 | − ·01 | +0·01 | −1·55 | −1·80 |
| 60 | − ·05 | +0·05 | −1·45 | −1·53 |
| 65 | − ·24 | −0·36 | −1·55 | −1·63 |
| 70 | − ·39 | −0·82 | −1·64 | −1·75 |
| 75 | − ·59 | −0·68 | −1·30 | −1·42 |
| 80 | − ·93 | −0·87 | −1·00 | −1·23 |
| 85 | −1·09 | −1·04 | −0·74 | −0·98 |
| 90 | −1·08 | −1·11 | −0·58 | −0·65 |
| 95 | −1·01 | −1·13 | −0·42 | −0·66 |
| 100 | −1·10 | −0·99 | −0·18 | −0·38 |
| 105 | −1·09 | −1·07 | +0·11 | −0·03 |
| 110 | −0·79 | −0·87 | +0·68 | +0·19 |
| 115 | −0·85 | −0·82 | +0·73 | +0·46 |
| 120 | −0·86 | −0·98 | +1·01 | +0·54 |
| 125 | −0·74 | −0·74 | +0·91 | +0·24 |
| 130 | −0·95 | −0·62 | +0·91 | +0·32 |
| 135 | −0·88 | −0·66 | +0·80 | +0·31 |
| 140 | −0·86 | −0·82 | +0·73 | +0·29 |
| 145 | −0·88 | −0·82 | +0·44 | +0·44 |
| 150 | −1·20 | −0·96 | +0·80 | +0·66 |
| 155 | −0·96 | −0·88 | +0·24 | +0·44 |
| 160 | −0·79 | −0·63 | +0·30 | +0·27 |
| 165 | −0·76 | −0·62 | −0·11 | +0·12 |
| 170 | −0·53 | −0·77 | +0·19 | +0·19 |
| 175 | −0·94 | −0·82 | +0·05 | +0·18 |
| 180 | −0·85 | −0·81 | +0·33 | +0·27 |
| 185 | −1·13 | −0·98 | +0·51 | +0·38 |
| 190 | −0·94 | −0·77 | +0·88 | +0·79 |
| 195 | −0·78 | −0·77 | +1·13 | +1·29 |
| 200 | −0·81 | −0·81 | +1·16 | +1·66 |
| 205 | −0·86 | −0·58 | +1·10 | +1·32 |
| 210 | −0·54 | −0·41 | +1·31 | +1·46 |
| 215 | −0·40 | −0·14 | +1·45 | +1·64 |
| 220 | −0·24 | −0·27 | +1·56 | +1·66 |
| 225 | −0·10 | −0·04 | +1·41 | +1·79 |
| 230 | −0·16 | +0·06 | +1·36 | +1·64 |
| 235 | +0·14 | +0·10 | +1·49 | +1·59 |
| 240 | +0·20 | +0·13 | +1·20 | +1·58 |
| 245 | −0·06 | +0·36 | +1·48 | +1·48 |
| 250 | +0·16 | +0·36 | +1·19 | +1·37 |
| 255 | +0·49 | +0·53 | +1·13 | +1·23 |
| 260 | +0·51 | +0·68 | +1·16 | +1·24 |
| 265 | +0·53 | +0·75 | +1·06 | +0·81 |
| 270 | +0·80 | +0·71 | +0·96 | +0·68 |
| 275 | +1·11 | +0·88 | +0·75 | +0·94 |
| 280 | +0·95 | +0·86 | +0·41 | +0·58 |
| 285 | +1·11 | +0·78 | +0·33 | +0·52 |
| 290 | +1·26 | +1·05 | +0·51 | +0·52 |
| 295 | +1·35 | +1·15 | +0·23 | +0·68 |
| 300 | +1·53 | +1·33 | +0·06 | +0·56 |
| 305 | +1·51 | +1·47 | +0·18 | +0·41 |
| 310 | +1·69 | +1·35 | −0·05 | +0·13 |
| 315 | +1·66 | +1·55 | −0·53 | −0·30 |
| 320 | +1·59 | +1·43 | −0·75 | −0·30 |
| 325 | +1·53 | +1·40 | −0·55 | −0·93 |
| 330 | +1·26 | +1·15 | −0·83 | −0·78 |
| 335 | +1·43 | +1·20 | −0·84 | −0·92 |
| 340 | +1·03 | +1·05 | −0·92 | −1·01 |
| 345 | +0·85 | +0·90 | −0·87 | −0·80 |
| 350 | +0·94 | +0·85 | −1·08 | −0·68 |
| 355 | +0·55 | +0·82 | −0·73 | −0·87 |

1 Division $= 0''\cdot312$.

Increased + readings of the horizontal screw correspond with motion of the mercury-dot on the eastern pivot towards the north.

Increased + readings of the vertical screw indicate that the mercury-dot on the eastern pivot is moving downwards.

If the pivots were truly circular and the observations were made without error, the figures of the preceding table would have their origin in non-coincidence of the mercury-dot with the axis of rotation, and would therefore be rigorously represented by the expressions :

$$\text{Vertical measures} \quad = a \cos \text{N.P.D} - b \sin \text{N.P.D.}$$

$$\text{Horizontal measures} = a \sin \text{N.P.D.} + b \cos \text{N.P.D.}$$

Forming equations of this type and solving by least squares we get :

| | | $a$ | $b$ |
|---|---|---|---|
| | | d | d |
| From the vertical measures, Group | I. | $-1\cdot11$ | $+0\cdot70$ |
| ,, ,, ,, | II. | $-1\cdot07$ | $+0\cdot90$ |
| ,, horizontal measures, Group | I. | $-0\cdot80$ | $+0\cdot77$ |
| ,, ,, ,, | II. | $-0\cdot79$ | $+0\cdot68$ |
| Means | ... | $-0\cdot94$ | $+0\cdot76$ |

Adopting these mean values of $a$ and $b$, and substituting them in the original equations, we get the following values (O – C), representing the errors of inclination and azimuth of the axis, which are due to the combined errors of the two pivots.

For convenience the results are converted into seconds of time at the equator, and the sign of the O – C residuals has been changed in the horizontal measures so that the + sign signifies an error of the western pivot in azimuth towards the north. In this way the signs of the tabular errors correspond with the signs which are habitually used in the reduction of our meridian observations, viz. the sign + indicates that the western pivot of the horizontal axis is too high, and that the line of collimation, when the observer is looking towards the south, points to the west of true south.

It should be remarked that these errors are entirely independent of any law, and the regular run which they exhibit shows how accurate were the observations.

*Table of Pivot Errors.*

| N.P.D. | Column I. *Level* Western Pivot too high. | Column II. *Azimuth* Western Pivot too far North. | N.P.D. | Column I. *Level* Western Pivot too high. | Column II. *Azimuth* Western Pivot too far North. |
|---|---|---|---|---|---|
| ° | s | s | ° | s | s |
| 0 | +0·002 | +0·006 | 180 | −0·013 | +0·001 |
| 5 | + 2 | + 10 | 185 | − 12 | + 8 |
| 10 | + 1 | + 6 | 190 | − 5 | + 6 |
| 15 | − 1 | + 10 | 195 | + 2 | + 6 |
| 20 | − 3 | + 8 | 200 | + 6 | + 9 |
| 25 | − 6 | + 8 | 205 | + 1 | + 9 |
| 30 | − 7 | + 3 | 210 | + 4 | + 6 |
| 35 | − 3 | + 1 | 215 | + 7 | + 4 |
| 40 | − 8 | + 0 | 220 | + 8 | + 6 |
| 45 | − 11 | − 5 | 225 | + 8 | + 4 |
| 50 | − 9 | − 5 | 230 | + 7 | + 6 |
| 55 | − 11 | − 7 | 235 | + 8 | + 4 |
| 60 | − 7 | − 9 | 240 | + 5 | + 6 |
| 65 | − 10 | − 5 | 245 | + 8 | + 8 |
| 70 | − 14 | − 0 | 250 | + 5 | + 7 |
| 75 | − 8 | − 2 | 255 | + 4 | + 4 |
| 80 | − 4 | + 2 | 260 | + 6 | + 4 |
| 85 | − 0 | + 4 | 265 | + 2 | + 5 |
| 90 | + 3 | + 3 | 270 | + 1 | + 4 |
| 95 | + 3 | + 1 | 275 | + 4 | + 0 |
| 100 | + 6 | − 0 | 280 | − 2 | + 3 |
| 105 | + 11 | − 1 | 285 | − 1 | + 4 |
| 110 | + 17 | − 6 | 290 | + 3 | − 0 |
| 115 | + 19 | − 7 | 295 | + 4 | − 2 |
| 120 | + 20 | − 6 | 300 | + 2 | − 5 |
| 125 | + 14 | − 10 | 305 | + 5 | − 6 |
| 130 | + 12 | − 9 | 310 | + 1 | − 6 |
| 135 | + 9 | − 9 | 315 | − 6 | − 9 |
| 140 | + 6 | − 7 | 320 | − 6 | − 7 |
| 145 | + 2 | − 6 | 325 | − 9 | − 6 |
| 150 | + 6 | − 1 | 330 | − 8 | − 2 |
| 155 | − 4 | − 4 | 335 | − 7 | − 5 |
| 160 | − 7 | − 7 | 340 | − 7 | − 0 |
| 165 | − 15 | − 6 | 345 | − 3 | + 2 |
| 170 | − 13 | − 5 | 350 | − 2 | + 0 |
| 175 | − 16 | + 1 | 355 | + 1 | + 3 |

The corrections applicable to observations with the Transit Circle on account of these errors of the pivots can, of course, be best applied to the original observations and determinations of instrumental adjustment; but as these observations were all reduced and printed before the pivot errors were definitely determined, it remains to consider how their effects on the Cape Catalogues for 1885 and 1890 can be computed.

*Effect of the Pivot Errors in the determination of Collimation.*

The collimation is determined by directing the telescope to two horizontal collimators, whose axes have previously been adjusted to coincidence. For sake of simplicity we shall assume that the common axis of both collimators lies true north and south.

When the Transit Circle is directed to the north collimator, the N.P.D. reading, in round numbers, is 34°, and when directed to the south collimator, 214°. Our table of pivot errors shows that, in these circumstances, the telescope points $0^s\cdot001$ E. of north, and $0^s\cdot005$ W. of south. The R.A. micrometer of the Transit Circle is graduated, so that an increase of the readings of the micrometer carries the whole system of wires to the west; that is to say, if the axis of the telescope is defined by any wire, increased readings of the micrometer imply that this axis is directed more towards the east. Thus the effect of pivot error is to make the readings on the north collimator too small, because by pivot error the telescope already points E. of true north.

| | |
|---|---|
| Thus the correction to the readings on the N. collimator is | $+\ 0^s\cdot001$ |
| ,, ,, ,, S. ,, | $-\ \cdot005$ |
| and the correction to the previously adopted reading for geometric collimation becomes | $-\ 0^s\cdot002$ |

Thus every observed transit requires a correction, on account of the error in collimator-determination produced by pivot error, of

$$\Delta c = -0^s\cdot002 \times \text{collimation factor.}$$

*Effect of Pivot Errors on the Determination of Level.*

The level error is determined by observing the micrometer reading for coincidence of the middle wire with its image as reflected from a pool of mercury. The Nadir reading, in round numbers, is 304°. The table of pivot errors, column 1, shows that at N.P.D. 304° the western end of the axis is too high by $0^s\cdot004$; therefore a correction of $-0^s\cdot004$ is required to find the reading for coincidence if the pivots were without error.

We have already found that the reading for geometrical collimation requires, on account of pivot errors, the correction $-0^s\cdot002$; hence, in the expression

Level error (high W) = "Reading for coincidence" – "Reading for collimation,"

we have to apply the correction

$$\Delta b = -0^s{\cdot}004 - (-0^s{\cdot}002) = -0^s{\cdot}002.$$

Thus the correction to the time of transit of any particular star on account of error of level produced by pivot errors is

$$\left\{\left(\begin{matrix}\text{Tabular correction from Col. I.,}\\ \text{argument N.P.D.}\end{matrix}\right) - 0^s{\cdot}002\right\} \times \text{Level factor.}$$

*Effect of Pivot Errors on the Determination of Azimuth.*

To represent general facts as nearly as possible, we shall assume that on every night azimuth was determined by observation of the transit of one circumpolar star of N.P.D. 178° at upper culmination, and of the transit of a star of the same declination at lower culmination (N.P.D. 182°).*

The time of upper transit of this imaginary circumpolar star will require the following corrections on account of pivot error :

$$\left.\begin{array}{l|rcrcr} & & & \text{Factors.} & & \text{s} \\ \text{Collimation} & -0^s{\cdot}002 & \times & +28{\cdot}65 & = & -0{\cdot}0573 \\ \text{Level} & (-0^s{\cdot}014-0^s{\cdot}002) & \times & +16{\cdot}82 & = & -0{\cdot}2691 \\ \text{Azimuth} & +0^s{\cdot}001 & \times & -23{\cdot}20 & = & -0{\cdot}0232 \end{array}\right\} = \Delta T_u = -0^s{\cdot}350$$

Similarly at lower transit :

$$\left.\begin{array}{l|rcrcr} & & & \text{Factors.} & & \text{s} \\ \text{Collimation} & -0^s{\cdot}002 & \times & -28{\cdot}65 & = & +0{\cdot}0573 \\ \text{Level} & (-0^s{\cdot}013-0^s{\cdot}002) & \times & -15{\cdot}16 & = & +0{\cdot}2274 \\ \text{Azimuth} & +0^s{\cdot}004 & \times & +24{\cdot}32 & = & +0{\cdot}0973 \end{array}\right\} = \Delta T_l = +0^s{\cdot}382.$$

The correction to the original azimuth on account of pivot errors will therefore be

$$\Delta a = -\left(\frac{\Delta T_u - \Delta T_l}{f_u - f_l}\right) = -0^s{\cdot}0154,$$

where $\Delta T_u$ and $\Delta T_l$ are the corrections above computed, and $f_u$ and $f_l$ are the azimuth factors at upper and lower culmination respectively.

Thus the correction to the time of transit of any particular star on account of error of azimuth produced by pivot errors is

$$\left\{\left(\begin{matrix}\text{Tabular correction from Col. II.}\\ \text{Argument N.P.D.}\end{matrix}\right) - 0^s{\cdot}0154\right\} \times \text{azimuth factor.}$$

*Effect of Pivot Errors on the Determination of Clock-correction.*

The clock stars employed were generally between declinations $+10°$ and $-10°$, a very few only being used beyond these limits ;

* It will be seen from the tables of azimuth determination in the Cape annual volumes that, on nights when star positions were determined, the azimuth always depended upon at least one upper and one lower culmination of circumpolar stars, but generally upon two upper and two lower culminations.

their mean N.P.D. may be taken as 90°. The mean of the corrections for N.P.D. 80°, 85°, 90°, 95°, and 100° on account of pivot error are, from our table :

In level + $0^{s}\cdot002$ and in azimuth + $0^{s}\cdot002$.

The time of transit of a clock star will thus require the following corrections on account of pivot error :

| | | Factors. | s | |
|---|---|---|---|---|
| Collimation | $-0^{s}\cdot002$ | $\times +1\cdot000 =$ | $-0\cdot002$ | |
| Level | $(+0^{s}\cdot002 - 0^{s}\cdot002)$ | $\times +0\cdot830 =$ | $\cdot000$ | sum $= -0^{s}\cdot009$ |
| Azimuth | $(+0^{s}\cdot002 - 0^{s}\cdot015)$ | $\times +0\cdot558 =$ | $-\ \cdot007$ | |

As the correction for clock error has the opposite sign from that of the time of transit, we have :

$$\Delta t = +0^{s}\cdot009.$$

Thus the complete corrections due to errors in the adopted instrumental corrections produced by pivot error are :

$$\begin{aligned} &\quad\ \ \text{s} \\ \Delta c &= -0\cdot002 \\ \Delta l &= -0\cdot002 \\ \Delta a &= -0\cdot015 \\ \Delta t &= +0\cdot009 \end{aligned}$$

And the corrections applicable to the right ascensions of the catalogues are :

$$\begin{aligned} &\ \{-\overset{\text{s}}{0\cdot015} + \text{Col. II. (Arg. N.P.D.)}\} \times \text{azimuth factor} \\ + &\ \{-0\cdot002 + \text{Col. I. (Arg. N.P.D.)}\ \} \times \text{level factor} \\ + &\ \{-0\cdot002 \qquad\qquad\qquad\qquad\qquad\quad\ \} \times \text{collimation factor} \\ + &\quad\ 0\cdot009 \end{aligned}$$

The corresponding quantities are given in the following table :

*Corrections on account of Pivot Errors.*

| N.P.D. | Collimation. | Level. | Azimuth. | Clock correction. | Catalogue Place. |
|---|---|---|---|---|---|
| ° | s | s | s | s | s |
| 35 | −0·003 | 0·000 | −0·024 | +0·009 | −0·018 |
| 40 | − ·003 | − ·002 | − ·023 | ... | −0·019 |
| 45 | − ·003 | − ·004 | − ·028 | ... | − ·026 |
| 50 | − ·003 | − ·004 | − ·025 | ... | − ·023 |
| 55 | − ·002 | − ·006 | − ·025 | ... | − ·024 |
| 60 | − ·002 | − ·005 | − ·025 | ... | − ·023 |
| 65 | − ·002 | − ·007 | − ·019 | ... | − ·019 |
| 70 | − ·002 | − ·010 | − ·013 | ... | − ·016 |
| 75 | − ·002 | − ·007 | − ·013 | ... | − ·013 |
| 80 | − ·002 | − ·004 | − ·009 | ... | − ·006 |
| 85 | − ·002 | − ·002 | − ·007 | ... | − ·002 |
| 90 | − ·002 | + ·001 | − ·007 | ... | + ·001 |
| 95 | − ·002 | + ·001 | − ·007 | ... | + ·001 |
| 100 | − ·002 | + ·004 | − ·006 | ... | + ·005 |
| 105 | − ·002 | + ·009 | − ·005 | ... | + ·011 |
| 110 | − ·002 | + ·015 | − ·005 | ... | + ·017 |
| 115 | − ·002 | + ·019 | − ·004 | ... | + ·022 |
| 120 | − ·002 | + ·021 | − ·002 | ... | + ·026 |
| 125 | − ·002 | + ·015 | + ·001 | ... | + ·023 |
| 130 | − ·003 | + ·013 | + ·003 | ... | + ·022 |
| 135 | − ·003 | + ·010 | + ·007 | ... | + ·023 |
| 140 | − ·003 | + ·006 | + ·009 | ... | + ·021 |
| 145 | − ·003 | ·000 | + ·013 | ... | + ·019 |
| 150 | − ·004 | + ·007 | + ·014 | ... | + ·026 |
| 155 | − ·005 | − ·012 | + ·023 | ... | + ·015 |
| 160 | − ·006 | − ·021 | + ·038 | ... | + ·020 |
| 165 | − ·008 | − ·049 | + ·053 | ... | + ·005 |
| 170 | − ·012 | − ·060 | + ·083 | ... | + ·020 |
| 175 | − ·023 | − ·130 | + ·125 | ... | − ·019 |
| 180 | − | ... | ... | ... | ·000 |
| S.P. 180 | ... | ... | ... | ... | ·000 |
| 175 | + ·023 | + ·078 | − ·070 | ... | + ·040 |
| 170 | + ·012 | + ·016 | − ·047 | ... | − ·010 |
| 165 | + ·008 | ·000 | − ·033 | ... | − ·016 |
| 160 | + ·006 | − ·003 | − ·017 | ... | − ·005 |

Small as these corrections are, there can be no doubt as to their reality. They show that, relative to stars near the equator,

Right Ascensions of stars observed with the Cape Transit Circle towards the Northern Horizon require a small negative correction.

This is exactly the opposite result which is derived from a comparison with other catalogues. This discordance may be due to change in the collimation of the Transit Instrument at different altitudes, and which cannot be eliminated in a non-reversible instrument, or it may arise from lateral refraction produced by the non-symmetrical arrangement of the building outside the shutter-opening.

Both these possible sources of error will be eliminated in the construction and installation of the new Transit Circle.

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*Note on Dr. Gill's Paper, "On a New Instrument for Measuring Astrophotographic Plates" (Monthly Notices,* lix. p. 61). By H. H. Turner, M.A., F.R.S., Savilian Professor.

In the last number of the *Monthly Notices* Dr. Gill describes a new instrument, constructed by Messrs. Repsold, for measuring photographic plates, which he considers an improvement on the instruments in use at Greenwich and at Oxford.* The main features of the Greenwich and Oxford instruments are:—

(1) Rectangular coordinates of the stars on the plate are obtained by referring each star image to the four réseau lines immediately surrounding it.

(2) The $x$ and $y$ coordinates of an image and the size of its disc are measured at the same time. [In some other instruments only one coordinate is accurately measured at one time; the plate is then rotated through 90°, and the other coordinate is measured. There are risks of mal-identification with this method, and it takes a longer time.]

(3) The coordinates are measured by means of *scales* in the eyepiece of the microscope, reading to 0·05 mm., and by estimation to 0·005 mm.

(4) It may be added, as a matter of detail, but a thoroughly important one, that the plate is measured twice in reversed positions (turned through 180°), which determines or eliminates personality in measurement and is a valuable check on mistakes.

Dr. Gill proposes no change in (1), (2), and (4), but substitutes for the scales mentioned in (3) two micrometer screws at right angles. He claims that such screws give a much greater accuracy in pointing on the star images, and I will concede him this point, which amounts to admitting that the *accidental error* of a pointing is diminished about one-half. But consider at what a cost this advantage is obtained!

* For description of the Oxford instrument see *Monthly Notices*, lv. p. 102.